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Claims

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[c1] A method for determining a subsurface formation property, comprising:

a determining a volume fraction of a layer in a multi-electrical-layer model for an anisotropic region of the formation, wherein the multi-electrical-layer model includes a relative-lower-resistivity layer and a relative-higher-resistivity layer and the determining is based on a resistivity measurement;

B determining a resistivity for the relative-lower-resistivity layer and a resistivity for the relative-higher-resistivity layer based on the volume fraction and bulk resistivity measurements of the anisotropic region, wherein the bulk resistivity measurements include a horizontal resistivity measurement or a vertical resistivity measurement; and

C determining the formation property based on the volume fraction, the resistivity of the relative-lower-resistivity layer, the resistivity of the relative-higher-resistivity layer, a porosity measurement of the anisotropic region, and the bulk resistivity measurements.

[c2] The method of claim 1, wherein the formation property

is a total water saturation.

[c3] The method of claim 2, wherein the water saturation is determined according to:

$$S_{wt} = 1 - \frac{\phi_T - [(1-VF)\sqrt{\frac{R_w}{R_{hr}}} + VF\sqrt{\frac{R_w}{R_{lr}}}]}{\phi_T}$$

wherein S_{wt} is the total water saturation, $\square_T$ is the total porosity of the anisotropic region, *VF* is the volume fraction of the relative-lower-resistivity layer, R_{hr} is the resistivity of the relative-higher-resistivity layer, R_{lr} is the resistivity of the relative-lower-resistivity layer, and R_w is a resistivity of formation water.

[c4] The method of claim 1, wherein the formation property is a bulk hydrocarbon volume.

[c5] The method of claim 4, wherein the bulk volume of hydrocarbon is determined according to:

$$BVH = \phi_T - [(1-VF)\sqrt{\frac{R_w}{R_{hr}}} + VF\sqrt{\frac{R_w}{R_{lr}}}]$$

wherein BVH is the bulk hydrocarbon volume, $\square_T$ is the total porosity of the anisotropic region, *VF* is the volume fraction of the relative-lower-resistivity layers, R_{hr} is the resistivity of the relative-higher-resistivity layer, R_{lr} is

the resistivity of the relative-lower-resistivity layer, and

R_w is a resistivity of formation water.

[c6] The method of claim 1, wherein the volume fraction is of the relative-lower-resistivity layer.

[c7] The method of claim 1, wherein the resistivity measurement is a high-resolution measurement.

[c8] The method of claim 7, wherein the determination of a volume fraction includes identifying bed boundaries based on the high-resolution resistivity measurement.

[c9] The method of claim 8, wherein identifying the bed boundaries includes finding inflection points on a derivative curve of the high-resolution resistivity measurement as a function of a borehole axial depth.

[c10] The method of claim 1, wherein the volume fraction is determined by summing thicknesses of thin layers having similar electrical properties.

[c11] The method of claim 1, wherein determination of the formation property is further based on a dual-water model or NMR data.

[c12] The method of claim 1, wherein the volume fraction or the formation property is determined within a depth or time index interval.

[c13] A system for determining a subsurface formation property, comprising:

a

a computer system adapted to process a program including instructions for: determining a volume fraction of a layer in a multi-electrical-layer model for an anisotropic region of the formation, wherein the multi-electrical-layer model comprises a relative-lower-resistivity layer and a relative-higher-resistivity layer and the determining is based on a resistivity measurement;

b

determining a resistivity for the relative-lower-resistivity layer and a resistivity for the relative-higher-resistivity layer based on the volume fraction and bulk resistivity measurements of the anisotropic region, wherein the bulk resistivity measurements include a horizontal resistivity measurement or a vertical resistivity measurement; and

c

determining the formation property based on the volume fraction, the resistivity of the relative-lower-resistivity layer, the resistivity of the relative-higher-resistivity layer, a porosity measurement of the anisotropic region, and the bulk resistivity measurements.

[c14] The system of claim 13, wherein the formation property is a total water saturation.

[c15] The system of claim 14, wherein the water saturation is determined according to:

$$S_{wt} = 1 - \frac{\phi_T - [(1-VF)\sqrt{\frac{R_w}{R_{hr}}} + VF\sqrt{\frac{R_w}{R_{lr}}}]}{\phi_T}$$

wherein S_{wt} is the total water saturation,

ϕ_T

is the total porosity of the anisotropic region, VF is the volume fraction of the relative-lower-resistivity layer, R_{hr} is the resistivity of the relative-higher-resistivity layer, R_{lr} is the resistivity of the relative-lower-resistivity layer, and R_w is a resistivity of formation water.

[c16] The system of claim 13, wherein the formation property is a bulk hydrocarbon volume.

[c17] The system of claim 16, wherein the bulk volume of hydrocarbon is determined according to:

$$BVH = \phi_T - [(1-VF)\sqrt{\frac{R_w}{R_{hr}}} + VF\sqrt{\frac{R_w}{R_{lr}}}]$$

wherein BVH is the bulk hydrocarbon volume,

ϕ_T

is the total porosity of the anisotropic region, VF is the volume fraction of the relative-lower-resistivity layer, R_{hr}

is the resistivity of the relative-higher-resistivity layer, R_{lr} is the resistivity of the relative-lower-resistivity layer, and R_w is a resistivity of formation water.

[c18] The system of claim 13, wherein the volume fraction is of the relative-low-resistivity layer.

[c19] The system of claim 13, wherein the resistivity measurement is a high-resolution measurement.

[c20] The system of claim 19, wherein determination of a volume fraction includes identifying bed boundaries based on the high-resolution resistivity measurement.

[c21] The system of claim 20, wherein identifying the bed boundaries includes finding inflection points on a derivative curve of the high-resolution resistivity measurement as a function of a borehole axial depth.

[c22] The system of claim 13, wherein the volume fraction is determined by summing thicknesses of thin layers having similar electrical properties.

[c23] The system of claim 13, wherein determination of the formation property is based on a dual-water model or NMR data.

[c24] The system of claim 13, wherein the volume fraction or the formation property is determined within a depth or

time index.